AN
INDEPENDENT SCIENTIFIC REVIEW

OF

THE TOXIC SUBSTANCES BOARD REPORT

MAY 1989

2023923472

Commissioned by

The Tobacco Institute of New Zealand

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F. Commentary by Dr CM Triggs, Department of Scientific and Industrial Research (New Zealand), Applied Mathematics Division

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APPROACH

In preparing this independent scientific review of the TSB report of May 1989, we have structured our approach around TSB Parts I and II.

For the convenience of the reader we have used the TSB structure and headings for cross referencing purposes. In adopting this procedure it should be noted that we do not necessarily accept the matters asserted by those headings.

We have not dealt substantively with the matters covered by pages xiii to xxix, pages 101 to 116, pages 125 to 131, and pages 137 to 139. It is similarly not to be taken that we, or the Tobacco Institute of New Zealand who commissioned this review, accept the information, comments, conclusions, recommendations, or other material in the pages specified above.

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SUMMARY

This independent scientific review of the Toxic Substances Board Report of May 1989 will demonstrate that:

1. Members of the Board have accepted, uncritically and at total face value, any scientific study that can be used to imply that smoking is undesirable. They have displayed a most unscientific selectivity in their use of scientific evidence, totally ignoring any evidence that does not fit comfortably with their hypotheses.

2. The Board agreed to hear presentations by experts in a number of areas covered by the Report, and then dismissed the views of these experts out of hand. The evidence of Professor Warburton, an internationally reputed scientist in the area of addiction, was summarily dismissed in one sentence. The account of Dr. Boyse's presentation and its implied rebuttal by Professor Beaglehole was inaccurate and petty.

3. Throughout the discussion of the medical aspects the Board have naively assumed that it is possible to identify a specific number of deaths that (they claim) are caused by cigarette smoking. It is certainly possible to estimate the annual numbers of deaths from the so-called smoking-associated diseases. However, it is not possible to determine whether any of these deaths could be stated to be caused by tobacco smoking and, if so, how many.

4. When discussing the claimed associations between smoking and certain diseases, the Board have totally ignored the critical distinction between association and causality. It cannot be proven by epidemiological studies that smoking is a cause of disease.

5. The Board also totally ignored evidence showing that animals exposed to cigarette smoke do not develop more lung tumours than unexposed animals. Similarly, the Board ignored a number of interesting anomalies in the epidemiological data, eg. that trends in disease usually do not match trends in cigarette consumption; there are many factors other than smoking that are associated with so-called smoking-associated diseases.

6. The report frequently refers to "deaths due to smoking" based on the paper by Gray et al, (1988). This paper forms the basis of the Health Department publication "The Big Kill", wherein deaths attributed to smoking in all the Hospital Board areas are listed in detail. If these estimates were reasonable, it would be expected that the estimates would correlate highly with the actual cancer deaths in each of the areas. The correlation in fact turns out to be slightly negative, and very weak, thus highlighting the dangers of regarding estimates as legitimate observations.

7. It is simply not valid, as the Board has attempted, to add up costs of hospitalisation and medical care from so-called smoking-related diseases and unquestioningly assume that they are all associated with smoking.

8. For determining smoking prevalence rates the Board have relied on Census and survey data; such sources are known to be highly unreliable for smoking-related statistics.

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9. The Board has consistently refused to take into account the worldwide corpus of independent research conclusions on, inter alia:

- the complexities of the role of advertising in general;
- how advertising operates in "mature", as opposed to developing, markets;
- children's response to advertising.

10. Careful study of the report shows it to be full of untenable assumptions, misleading data, faulty statistical methods, errors and contradictions. Specifically:-

- The authors have made fundamental assumptions about how advertising works. These assumptions are almost all demonstrably wrong.
- Market survey data covering tobacco consumption is always prone to very considerable error which invalidates all conclusions drawn from this source.
- The report uses tobacco consumption data in a selective and partial manner.
- The report bases many of its judgements on a small scale literature review omitting some of the most important contributions to the debate. Crucially, the report excludes previous literature reviews - a serious omission.
- The report contains a large number of mistakes ranging from the evident lack of appreciation of simple statistical practices, to the inclusion of contradictory statements.

11. An independent and statistically correct re-analysis of the TSB data provides firm evidence that:

- Advertising bans and restrictions have little or no impact on consumption of tobacco products.
- Advertising bans do impede the growth of the market share of filter cigarettes (and hence probably also the growth of low tar cigarette types).

These conclusions are broadly in line with the results of literature reviews undertaken by independent Government agencies and academics who have reviewed the evidence relating to the impact of advertising in general terms and of tobacco advertising in particular.

12. The Board have failed to take into account that in any democratic nation it is axiomatic that the freedom of commercial speech, in parallel with the freedom of speech on religion, politics, science and aesthetics, is critical to freedom of choice and the autonomy of the individual. Freedom, in essence, is the right to choose and this includes the right to make choices that others may disapprove of. If the state controls the flow of commercial speech, whether comprehensively or for specific aspects, political and economic democracy are no longer viable.

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13. The Board have shown a remarkable lack of understanding of how consumers respond to advertising in general and to cigarette advertising in particular. They do not appreciate that consumers erect a series of psychological barriers against advertising messages.

14. The Board's selection of available studies is shown to be most inadequate, in that:

- it has failed to examine the several major literature reviews now available.
- it has failed to examine evidence from studies of similar industries (eg. alcohol).
- the conclusions are highly dependent on the results of five studies all of which have been the subject of serious criticism in the literature.

Such a partial and incomplete selection of material fails to reflect the conclusions reached by Government agencies in other countries where rigourous analysis of the subject has been recently undertaken.

For example, the US Federal Trade Commission Bureau of Consumer Protection have stated that "Most of the large number of studies of cigarette company advertising have found little or no effect of changes in total advertising on total consumption".

Again in the latest US Surgeon General's report it is conceded that: "There is no scientifically rigourous study available to the public that provides a definitive answer to the question of whether advertising and promotion increase the level of tobacco consumption" and that "the .... extent of influence of advertising and promotion on the level of consumption is unknown and possibly unknowable".

It is therefore clear that the Board's modest literature review has led them to conclusions that are diametrically opposed to those reached recently by other independent, and more thorough, appraisals.

15. A large number of research studies, conducted by organisations not connected with the tobacco industry have investigated smoking behaviour among children and teenagers in several countries, including New Zealand. Peer pressure, family influences, curiosity and a number of lesser influences (which do not include advertising) are the key factors persuading young people to take up smoking. No firm data has been uncovered to suggest that cigarette advertising induces young people to take up smoking, or to resume smoking after a period of time has elapsed. On the contrary, study after study has indicated that not only are children and teenagers fully aware of the tobacco and health controversy, but also that they are capable of recognising cigarette advertisements for what they are.

16. The findings of independent studies demonstrate that the actual effect of advertising on children is widely different to those findings used by the Board in arriving at their conclusions.

17. The facts are:

- That primary school children are capable of recognising advertisements for what they are and children of this age group are particularly suspicious of cigarette advertising.

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- That liking for a particular product category or a brand within a category is associated with liking for advertisements featuring them. In other words it may be an inclination to smoke (caused by other factors) which attracts a person to a cigarette advertisement, rather than the reverse.

18. The Board's conclusion that tobacco advertising to promote brand switching leads to increases in adult consumption is totally at variance with the views of worldwide authorities. It reveals the Board's failure to comprehend what brand preference advertising can do, particularly in "mature" markets:

- Brand preference advertising seeks only small changes in consumer behaviour.
- In established markets when one brand succeeds it usually does so at the expense of another brand. Thus in a stable or declining market, for every winner there must be a loser.
- Normal brand advertising neither attempts to stimulate sales of the product type as a whole, nor aims itself at people who are not in the market for the product.
- Many available studies indicate that even very large increases in brand preference advertising have no impact on aggregate or total demand for the products in question. The cigarette market in the UK provides a good example of the lack of influence brand advertising has on total sales.

19. The methodology of the 33 country study, which is the key to the Board's case that advertising bans are accompanied by falls in tobacco consumption, has been shown to be deficient in a number of respects. Among the most critical:

- Some of the key conclusions are based on only one country, not 33 countries.
- Some of the key conclusions rest on elapsed time periods of one year to three years and not 16 years.
- The survey data do not provide reliable consumption data.

20. The 33 country study also contains a great many errors and misconceptions, and much invalid data and analysis. When the uncertainties in the raw data are of such a magnitude compared to the predicted effect (up to 7 percent), serious doubts have to be cast on the value of the conclusions.

The study's conclusions therefore cannot be regarded as a reasonable basis for policy decision making.

21. After application to the New Zealand Health Department study of the correct statistical techniques the results are quite different. In the 33 countries, the largest decrease in use of tobacco is shown to be in those which permit advertising in most media.

Countries that permit advertising in all media have a greater decrease in tobacco use than countries that allow no advertising at all.

The true conclusion to be drawn from this study is therefore the precise reverse of that drawn by the Board.

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22. In New Zealand, tobacco consumption has already fallen faster than in any country that has instituted a tobacco advertising ban - for whatever reason - since 1975. This analysis of the TSB report demonstrates that further restrictions on tobacco advertising in New Zealand would have no measurable impact on tobacco consumption.

IN CONCLUSION

THE TOXIC SUBSTANCES BOARD REPORT IS FULL OF UNTENABLE ASSUMPTIONS, MISLEADING DATA, AND FAULTY STATISTICAL METHODOLOGY. INDIVIDUALLY, THESE VARIOUS CRITICISMS INVALIDATE LARGE SECTIONS OF THE REPORT. COLLECTIVELY, THEY INDICATE THAT ITS CONCLUSIONS CANNOT BE REGARDED AS A REASONABLE BASIS FOR PUBLIC POLICY DECISION MAKING.

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PART I

TOBACCO AND ITS EFFECTS

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1 *A profile of tobacco*

The Report states that:

"Tobacco smoke contains over fifty toxic and cancer-causing chemicals" (TSBR p3).

This statement will be considered in section 1.2; it is, however, clearly an over-simplification.

The Report states that

"... twenty cigarettes yield some 300 milligrams of tar and 30 milligrams of nicotine at the smoker's end of the cigarette" (TSBR p3).

This is also an over-simplification because of course this would depend entirely on the brand smoked. In New Zealand, yields for tar range from 4 to 20mg, ie. 80 to 400 per pack of 20, and for nicotine range from 0.5 to 2.0mg, ie. 10 to 40mg per pack of 20.

"Addiction to nicotine ensures that most users inhale this smoke for decades, a sufficient duration and dose for disease or death to result in about one quarter of cases" (TSBR p3).

The Report totally ignores the fact that there is still a controversy over whether smoking is addictive. This is considered under section 1.3.

1.1 *Toxicity*

"The toxicity of tobacco is related to the known toxic properties of nicotine (nicotine is a powerful poison affecting heart and blood vessels....)" (TSBR p3)

(i) The fact that nicotine is a "powerful poison" has no relevance to cigarette smoking, and this is the first of many examples in the Report in which toxicological data is taken out of context. In doses orders of magnitude higher than those taken in from tobacco, nicotine is indeed a poison. However, most chemicals will eventually cause severe damage if taken in exceptionally high doses.

(ii) The view of the Board that nicotine (in doses relevant to tobacco smoking) is a toxic substance contrasts with the views of other groups or individuals that can be considered to be experts in the area. For example, the UK government advisory body, the Independent Scientific Committee on Smoking and Health (ISCSH) in their 1983 and 1988 reports considered that the majority of evidence "indicated that nicotine in the dose delivered by smoking was not harmful to a healthy individual". At a recent symposium organised by the ISCSH, a number of international experts were brought together. Dr F J C Roe, an international expert in toxicology and cancer research noted that nicotine "... is not teratogenic, genotoxic, or carcinogenic". At the same symposium, Drs Levy and Martin noted that "... the epidemiological data available would seem to mitigate against nicotine being cardiotoxic". (See Wald and Froggatt, 1989). N L Benowitz noted that "While there are clearly significant changes in CNS receptors and the activity of neurotransmitter systems during prolonged exposure to nicotine, there is no evidence that nicotine produces any direct, permanent CNS toxicity".

(iii) The controversy over whether or not nicotine is addictive is considered in section 1.3.

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"The toxicity of tobacco is related to.... biologically active substances either in tobacco or generated by its combustion, such as carbon monoxide, hydrogen cyanide and ammonia" (TSBR p3).

This statement can be applied to some of the compounds in cigarette smoke, but only under very specific conditions.

- "Toxicity" can be applied both to a mild irritant and to an acute deadly poison.
- Carcinogens are frequently organ-specific and active only at certain doses and by certain routes of administration. Many of the studies of the above compounds have no relevance to tobacco smoking.
- Issues other than chromosomal damage are important in mutagenicity. Mutagenicity does not directly relate to human carcinogenesis.

1.2 *The cancer-causing properties of tobacco*

"Of the chemicals in cigarette smoke, forty-three are complete carcinogens..." (TSBR p3)

Compounds can rarely be considered to be "complete carcinogens" except with reference to a specific set of dosage and exposure requirements. The Board fails to note that the International Agency for Research on Cancer (IARC) classifies these 43 compounds as **animal** carcinogens, and only two have been suggested to be possible human carcinogens. All 43 compounds are present in very small amounts in cigarette smoke compared to the doses investigated in animal studies.

"Among the carcinogens in tobacco smoke, certain volatile nitrosamines, substances found only in tobacco or the gas phase of tobacco smoke, are potent carcinogens in animal models" (TSBR p3).

This statement is incorrect. The volatile nitrosamines present in tobacco smoke are not unique to tobacco, but are widespread in food and consumer products. Beer and bacon contain high concentrations, as does the air in new motor cars. The Board presumably meant to refer to involatile nitrosamines, since certain compounds of this type have been found that are unique to tobacco. In the ISCSH symposium referred to above, Roe noted that a small number of investigators have suggested that those nitrosamines may be implicated in human lung cancer, and concluded: "There is, in fact, no direct evidence of such implication; in particular there are no data from animal studies involving inhalation exposure to any of the tobacco-derived nitrosamines".

It should also be pointed out to the Board that attempts to infer carcinogenic potency in man from carcinogenicity tests in animals is a procedure fraught with difficulty and avoided by most toxicologists.

"The cancer-causing properties of tobacco are particularly related to the tar condensate, but not confined to it, and many cancer-causing chemicals are found in the gas phase of the smoke" (TSBR p3).

The number of chemicals that have been shown to cause cancer in animals under some circumstances and which are also present in the gas phase of cigarette smoke is small. Moreover, for some of these, animal carcinogenicity was seen only after exposure to very high doses, and the extrapolation of such data to the human situation is highly controversial.

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1.3 *Nicotine and the addictive properties of tobacco*

Paragraph one is an anecdotal report from one smoker and can hardly be considered as scientific evidence. The report makes no mention of the large number of smokers that have given up cigarette smoking without major problems.

"Nicotine is the addictive element in tobacco. The criteria for addiction, as internationally recognised by such bodies as the World Health Organisation, the Office of the United States Surgeon General, and the American Psychiatric Association, are met when..." (TSBR p4)

The criteria that follow this statement are taken from a variety of sources, none of which are the WHO or the APA. This is a gross distortion because the WHO abandoned the use of the term "addiction" in the late 50's and the APA have not defined addiction at all in any of their Diagnostic and Statistical Manuals. Discussion of these individual criteria for "addiction" can be found in Professor Warburton's recent, peer-reviewed publication (Appendix A).

"A psychoactive substance is present..." (TSBR p4)

The paragraph reiterates the statement of the Surgeon General that an addictive substance must have psychoactive properties. However, this is a meaningless criterion because it is very obvious that drugs like anti-depressants and anti-psychotic drugs have psychoactive properties, but no-one would argue that these substances are addictive.

"... 76 percent considered "cigarette smoking to be like a drug addiction" and 80 percent of current smokers answered yes to the question "Do you think you are addicted to cigarettes?" (TSBR p4)

This finding is obtained consistently, because the word "addiction' is used in many different sorts of senses in common parlance. It can refer to many innocuous activities. The fact that smokers will agree to the statement that they are addicted to cigarettes only means that they have an inclination to that particular sort of activity. Some people in New Zealand would agree that they are addicted to rugby.

"... the drug's pharmacological activity is sufficiently rewarding to maintain self-administration" (TSBR p4).

This criterion touches on the contentious issue of self-administration. It is obvious that smokers self-administer nicotine; however, people self-administer many other sorts of things. For example, food is rewarding enough to maintain self-administration, and yet no-one would argue that food is addictive.

"... increasing doses are required to achieve a specific intensity of response" (TSBR p4).

This statement is patently untrue for nicotine. While opiate users take up to 50 times the analgesic dose as the result of tolerance, smokers maintain a regular level of cigarette consumption throughout their smoking history. There is no evidence at all that smokers are increasing their doses. Indeed, as Professor Warburton pointed out in his written submission to the TSB, the evidence from compensation studies is that smokers have reduced their dose as they have switched to lower yield cigarettes and, on average, are now taking in considerably less nicotine than they were in the past.

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"Physical dependence, characterised by a withdrawal syndrome, is evident" (TSBR p4).

Exactly the same point can be made, that smokers over the years have reduced the amount of nicotine that they are taking in and very clearly there is no evidence of these withdrawal symptoms. Indeed, 25 percent of smokers do not experience any sort of symptoms when they stop smoking; of those who report symptoms, the experiences are extremely variable. This contrasts with the 100 percent of hard drug users who experience the same, stereotyped withdrawal symptoms.

"This dependence is indicated by the fact that cigarettes have to contain a certain amount of nicotine before they will satisfy smokers - nicotine-free tobacco substitutes have been market "flops"" (TSBR p4).

We assume that the TSB is referring to tobacco substitutes such as NSM and Cytrel which were marketed in cigarettes containing 75 percent natural tobacco of high nicotine content.

"The cure rate one year after treatment in smoking cessation clinics is low, about 20 percent, similar to relapse rates with other drugs of addiction treated in clinics ..." (TSBR p4)

This paragraph is a citation of data from the 1960's smoking cessation clinics. At that time, the attitudes to smoking were vastly different and one cannot extrapolate from those data to today. Even today, people who attend smoking clinics are a very specific group within the population; they attend for many other reasons than cessation, eg. companionship, etc. To compare them directly with those who attend clinics for use of "hard" drugs is invalid.

From the population at large, it is obvious that a considerable proportion of the smoking population in the United States and the United Kingdom have given up smoking.

"Recurrent drug cravings occur. This is the personal reality of tobacco addiction" (TSBR p4).

As discussed in Professor Warburton's paper (Appendix A), the concept of craving is invalid.

"At a meeting of the Tobacco Subcommittee... Professor David Warburton... attempted... to dismiss the idea that tobacco use is addictive... Professor Frederick Fastier... convinced the Subcommittee that the Surgeon General's view regarding addiction is correct" (TSBR p4).

Professor Warburton's views, which were presented to the Tobacco Subcommittee, have now been peer-reviewed and published in the Bulletin of the British Psychological Society (Warburton, 1989). The report dismisses in one sentence, and with no justifications, the views of Professor Warburton, who is a recognised expert in the field of addiction and who was invited on this basis to contribute to the US Surgeon General's Report on addiction. He also acts as Technical Advisor to the Food and Drug Administration of the USA, and has given advice to the UK Independent Scientific Committee on Smoking and Health. The Board give no explanation of how Professor Fastier succeeded in convincing them that the views of an expert could be so summarily dismissed. In fact, during the meeting referred to, Professor Fastier proved reluctant to use the term "addiction", and was not heard to present any arguments against Professor Warburton's submission to the Board. This dismissal of Professor Warburton with no supporting justification is hardly indicative of a fair scientific review, and indicates that the Board have prejudged the matter.

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"Two types of dependence are commonly recognised ... Whichever mechanism is the more important it is indisputable that "the tobacco habit" can be very hard to break" (TSBR p4).

It is difficult to distinguish between physical and psychological dependence. On the one hand the Board insists that tobacco use is an addiction, on the other hand they refer to it as a habit that is hard to break. This shows the rather sloppy and superficial approach of the Board in this respect: the two terminologies have very different implications. Dr Michael Russell, of the Addiction Research Unit, Maudsley Hospital, London, (1976) said: -

> "A state of dependence is a normal part of human nature. It is abnormal not to suffer over the loss or lack of important objects. Most people are fortunately dependent on a whole array of objects thereby reducing the degree of dependence on any single one of them. Some of the objects and activities on which people are commonly dependent are: drugs, motorcars, smart clothes, antiques, animals, people, sport, hobbies, work, clubs, gardening, playing cards, gambling, music, television, sweet foods, books, newspapers, trees and open spaces, holidays, political and religious activities".

He continued:-

> "Given that we are all dependent to varying degrees on a wide variety of objects and activities, it is only some drugs, some objects and some activities that we attempt, or are caused to attempt, to resist or to do without. Unless there is forced withdrawal or strong motives to resist, such as the danger of physical or social damage or strong social disapproval, a state of dependence may remain hidden. A mild degree of dependence on cannabis or certain palatable foods may be only too apparent because the illegality of the one and the undesired fattening effect of the other, expose the dependence by motivating attempts to control or desist from indulgence. But a high degree of dependence on hard work, music, or gardening may remain hidden in that social approval of such activities makes attempts to desist unlikely, and the difficulty or even the impossibility of desisting are consequently seldom exposed".

In summary, Russell suggests that the only difference between accepted dependencies and the rest is society's attitude, not the substance.

"The Subcommittee recognised that the degree of addiction among smokers varies widely" (TSBR p5).

There is no objective and quantitative measure of addiction. It is therefore difficult to see how the Board would suppose that the "degree of addiction among smokers" could be calculated.

"As the United States Surgeon General's 1988 report concludes... The immediate past Director General of the World Health Organisation, Dr Halfdan Mahler, has taken a similar position" (TSBR p5).

The conclusions of the US Surgeon General can easily be refuted; this is clear from Professor Warburton's submission to the Board and publication (Appendix A). Dr Mahler, incidentally, is not an expert in the field of addiction, and therefore this position represents his personal opinion only.

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"These conclusions of scientific and health bodies accord with the commonsense understanding of tobacco - that it is very difficult to stop using" (TSBR p5).

A "commonsense understanding of tobacco" bears no relation to science. Many habits are difficult to break, but this does not mean that they are addictive. People find it very difficult to give up or "stop using" anything that they enjoy. In any case, millions of smokers worldwide have given up smoking.

"Although it is true that tobacco dependence does not involve the disorder and crime associated with illegal drugs, this to some extent stems from the historical accident of the legality of tobacco" (TSBR p5).

Disorder and crime are not associated with tobacco because tobacco does not have the effects of the illegal drugs, ie. there is no intoxication, no disruption of social or personal functioning etc. The Board is straying into areas (criminology) beyond its expertise, and upon which it clearly needs assistance.

"Tobacco clearly causes more sickness, more avoidable death and more untimely bereavement than all other drugs combined (Figure 1.3)" TSBR p6).

This is a major misrepresentation. The figures in this graph have been obtained by very different means. The number attributed to cigarette smoking is an estimate obtained by applying prevalence figures and relative risks estimated from pooling a number of overseas studies to population figures. Numbers attributed to alcohol and illegal drugs, on the other hand, are not calculated by this method, and therefore are not attributed deaths, but counts obtained from death certificates. This is clearly a comparison of like with unlike.

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2 *The health consequences of tobacco use*

"Tobacco deaths worldwide annually equal the adult population of New Zealand" (TSBR p7).

This is a meaningless statement. It is impossible to determine whether any individual has died as a consequence of exposure to any one of the numerous risk factors that all individuals are exposed to. No disease is uniquely associated with tobacco use; it is therefore invalid to advance such a calculation.

"The scientific evidence ... is weighty, and sufficient to convince the Toxic Substances Board beyond a shadow of a doubt" (TSBR p7).

It is disturbing to hear an assemblage of persons such as the Toxic Substances Board profess to being convinced "beyond a shadow of a doubt" by any scientific issue. Most judicial tribunals after hearing full argument and exhaustive evidence (with all the checks and balances of the long-established rules of evidence) ordinarily have far greater difficulty and diffidence in accepting that a matter is proved beyond reasonable doubt (the criminal standard) or even on the balance of probabilities (the civil standard). For the TSB to be so emphatic in its decision to accept one rather than the other side of a complex and on-going scientific controversy strains credulity. It points to a predisposition and prejudgement irrespective of the facts (or absence of them).

The scientific evidence that is used as a basis for the assertion that tobacco causes disease is almost entirely epidemiological. Can epidemiological evidence alone be considered to be "weighty" when such biological evidence as there is, is unconvincing? The US Surgeon General in 1964 asserted that "Statistical methods cannot establish proof of a causal relationship in an association". Sir Ronald Fisher, an eminent statistician, noted in 1959 that statistical methods can reject an hypothesis, but can never establish that an hypothesis is certainly true. This general principle is a basic tenet of all textbooks of statistics.

Similarly, a number of scientists with international reputation have not, unlike the members of the Toxic Substances Board, been convinced "beyond a shadow of a doubt".

For example, the eminent medical physicist Professor Philip Burch in 1978 made the following statement based on a detailed review of the epidemiological evidence:

> **"It is argued that no definitive conclusions can be reached, as yet, about the extent of any causal link between smoking and lung cancer. It is very doubtful, however, whether the entire association observed between smoking and lung cancer in occidental males should be interpreted in causal terms".**

"Smokers who die of smoking die on average twenty-one years earlier than those who have never smoked regularly" (TSBR p7).

This is another statement that is inherently incapable of justification. As noted above, it is impossible to determine that any given smoker died of smoking. Statistics simply do not bear out the assertion that smokers die twenty-one years earlier than non-smokers.

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Source: https://www.industrydocuments.ucsf.edu/docs/qmbl0000

2.1 *The global health consequences of tobacco use*

"About two-and-a-half million people die every year from all the diseases caused by tobacco" (TSBR p7).

It is certainly possible to determine the annual number of deaths from the so-called smoking-associated diseases; however, it is not possible to determine whether any of these deaths were caused by tobacco smoking, and if so, how many. Death certificates (the major source of information on cause of death) do not record whether or not the individual was a smoker.

"In developed countries, cigarettes are linked to at least 80 percent of all deaths from lung cancer..." (TSBR p7)

To repeat previous comments, it is simply not valid to make this kind of calculation. There are too many factors involved in the aetiology of this disease, many of which are present in the same individual, to ever be sure what proportion of deaths is due to any given factor.

2.2 *The evidence*

"The adverse health effects of tobacco use have been scientifically recorded ..." (TSBR p7).

This is yet another overstatement. The adverse health effects of tobacco use have not been scientifically recorded; suggestions have been made but causality has never been proven.

"Tobacco industry executives and scientists were among the first to know that cigarettes were dangerous to health..." (TSBR p7)

This reference to the Cipollone case is a rather glib one, is hardly relevant in a supposedly scientific discussion and is far beyond the expertise of the Board.

Had the Board studied the Cipollone case and its related scientific issues in detail, they would know that mouse skin-painting studies are not, and have never been, accepted by the scientific community (inside or outside of the tobacco industry) as sufficient evidence to be sure that a substance is harmful to human health.

"The first report of the US Surgeon General on smoking and health, in 1964, showing that smoking causes lung cancer and is linked to other diseases ... smoking causes lung cancer" (TSBR p7)

The Surgeon General's report was a review of studies that claimed to show associations between smoking and various diseases. It was the Surgeon General's judgement that this meant that smoking caused lung cancer. Other scientists have not made the same judgement. Since epidemiological studies can never prove causality, it is still an open question.

"Ten years passed before cigarette manufacturers in New Zealand, under pressure from the government, placed a warning on cigarette packets. No mention, however, was made of lung cancer in the warning" (TSBR p7).

As in other parts of the world, the content of the warning notice on the side of New Zealand cigarette packets is directed by the government, not by the tobacco industry. This should be clear from the attribution to the Department of Health.

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"... in a 1985 letter to the Minister of Health on the effects of smoking on disease, the Colleges of Medicine, representing virtually all specialist doctors in New Zealand ..." (TSBR p8)

This letter is an opinion and does not carry any scientific weight at all. Unanimity (often through lack of awareness of all of the facts) does not equal proof.

2.3 *The evidence updated*

2.3.1 *Diseases caused by smoking*

The following section briefly considers, for each of the diseases listed in section 2.3.1 of the Report (in the highlighted grey section), anomalies in the evidence associating these diseases with cigarette smoking.

"a cause of increased premature overall mortality in men and women; a cause of increased overall morbidity" (TSBR p8).

See comments by Sage Consultants (Appendix B); see also comments on Chapters 3 and 4.

"the major cause of chronic bronchitis; the major cause of emphysema" (TSBR p8).

Although many scientists and members of the medical profession have concluded that smoking causes chronic obstructive lung disease (COLD) (bronchitis and emphysema) a number of other findings exist which do not sit comfortably with such a theory and which have not been adequately taken into account when reviewing the evidence.

(i) **A large number of studies have pointed to factors other than smoking that are associated with COLD: for example, social class (eg. Burr and Holiday, 1987) and occupation (eg. Becklake et al, 1987; Korn et al, 1987). Sterling (1984) raised the possibility that smoking may actually exhibit a certain preventative effect in some occupational exposures.**

Environmental exposures and air pollution have also been raised as important risk factors (Euler et al, 1987; Gamble et al, 1987, Garshick et al, 1987). Some individuals inherit a gene which results in them having only very small quantities of a naturally-present chemical that protects the lung from decreasing elasticity. As a result of the deficiency of this chemical, emphysema can occur. Five percent of all emphysema patients have this deficiency (alpha 1-antitrypsin deficiency). It has also been suggested that COLD clusters in families, regardless of smoking habits of the families (Cohen and Chase, 1978).

Occurrence of respiratory disease in childhood predisposes to the development of COLD when adult, regardless of later smoking habits (Royal College of Physicians, 1983). Reid et al (1983) found that breathing high oxygen concentrations can cause lung injury, which is of particular interest since increased oxygen levels are often used in the treatment of chronic lung disease.

(ii) **COLD has been declining for a number of years now, and the decline began before it could be assumed that any decline in smoking habits was having an effect. Peach (1986) suggested that in England and**

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Wales, for people aged 45 onwards, chronic bronchitis and emphysema have been significantly declining since 1963.

"a major cause of coronary heart disease in men and women" (TSBR p8)

(i) The Surgeon General (1979) states that cigarette smoking is an important risk factor for coronary heart disease, but notes that it is not essential and nor is it, in those parts of the world where people have low cholesterol levels, as strong a risk factor as in the United States. Other scientists have taken a stronger view of this discrepancy; the British Medical Journal (Editorial, 1982) reported the following results from a conference on coronary heart disease:

> "Professor Geoffrey Rose and other speakers from the United States and Europe seemed agreed that in population studies dietary changes had the most important effect on the incidence of coronary heart disease - much more than did changes in smoking ... The relative freedom of the Japanese from coronary heart disease, despite their very heavy smoking, was good evidence that tobacco was no great threat to an otherwise healthy heart".

Systematic comparisons of different populations show large differences in the incidence of coronary heart disease (Shaper and Pocock, 1987; Keys, 1970).

(ii) There is no known mechanism by which smoking could be believed to affect myocardial infarction. Any effects of nicotine and carbon monoxide on the cardiovascular system are short-lived, and myocardial infarction does not usually coincide with the smoking of cigarettes.

(iii) A number of epidemiological studies have also failed to detect an association between smoking and coronary heart disease (eg. Lapidus et al, 1986; Menotti et al, 1987).

(iv) Hopkins and Williams (1981) claimed that 245 different risk factors have been associated with coronary heart disease. These include, amongst the most significant, diet, hypertension, alcohol, dietary salt, obesity, sociological indices, anxiety and neuroticism, life problems and stress.

(v) Whilst it is frequently stated by medical authorities that heart disease is increasing in many countries, Stehbens (1987) questions whether this is the case, criticising the types of evidence used to come to such conclusions. Leeder et al (1984) also believe heart disease to be declining, as do Ragland et al (1988) who suggested that heart disease among men in the USA had been declining since 1960.

"a cause and the most important risk factor for atherosclerotic peripheral vascular disease" (TSBR p8).

(i) A number of pathological and environmental factors have been associated with the development of peripheral atherosclerosis. These include raised blood pressure, diabetes mellitus, lipoprotein cholesterol and serum triglyceride concentrations. (Fowkes, 1989).

(ii) Evidence linking smoking and atherosclerosis is primarily from autopsy work. The US Surgeon General (1979) notes that there is

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inconsistency in the autopsy literature as to whether or not smoking history is found to be statistically significant, and that autopsy studies documenting smoking behaviour have not generally permitted analysis for risk factors other than smoking that might affect the severity of atherosclerosis. These studies are therefore very poorly controlled.

(iii) No known mechanism exists to explain why smoking would be associated with atherosclerosis. Again, the US Surgeon General (1979) notes that experiments on the effects of nicotine or carbon monoxide on experimental atherogenesis in animals have produced conflicting results and are inconclusive.

"a cause of cerebrovascular disease" (TSBR p8).

(i) The US Surgeon General (1979) noted that the results of the various epidemiological studies on smoking and stroke had not been congruent and that no conclusion could be stated with confidence. Studies suffer from deficiencies such as small sample numbers, failure to consider separately cerebral haemorrhage and ischaemic infarction, failure to consider separately men and women, and inadequate classification by age. He suggested that other risk factors are so much more important that an effect of smoking could not be detected. The 1989 Report of the Surgeon General, however, concludes that causality has in fact been established. The change of mind was apparently based on studies since 1983. However, Shinton and Beevers (1989) recently noted:

"the relationship between cigarette smoking and stroke has never been clear cut. Reviews and major textbooks over the past 10 years have considered smoking to be either an unlikely or a possible but uncertain risk factor".

In many of the studies on smoking and stroke the alleged risk is in the region of 1 to 2, which makes interpretation even more difficult than in epidemiology in general. Sir Richard Doll and Richard Peto (1981) pointed out that when the rates "among exposed people are only a moderate multiple of those among the unexposed (eg. when the relative risk lies between 1 and 2)... problems of interpretation become acute, and it may be extremely difficult to disentangle the various contributions of biased information, confounding of two or more factors and cause and effect".

(ii) Other suggested risk factors for stroke include hypertension, diabetes, alcohol abuse, oral contraceptives, migraine headaches, serum lipid level, blood glucose concentration, plasma fibrinogen concentration, large waist circumference, high hip: waist ratio, low vital capacity, family history, and coal fumes (Colditz et al, 1988; Oleckno, 1988; Bonita et al, 1986; Zhang et al, 1988; Wein et al, 1987).

"associated with increased mortality from atherosclerotic aortic aneurysm" (TSBR p8).

(i) Aortic aneurysm is an uncommon cause of death (less than 1 percent of cardiovascular deaths) and there have been few adequate studies carried out that accurately assess the effects, if any, of smoking. Data permitting multivariate analysis in terms of other conventional risk factors are unavailable.

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(ii) Nothing, other than the epidemiological associations in a small number of studies, is known about smoking and aneurysm formation in man.

"the major cause of lung cancer in men and women" (TSBR p8).

Although a number of epidemiological studies have led many scientists and members of the medical profession to conclude that smoking causes lung cancer, a number of other findings exist which do not sit comfortably with such a theory and which have not been adequately taken into account by these groups when reviewing the evidence.

(i) The US Surgeon General (1982) published relative risk ratios for 35 retrospective studies that had examined the association between smoking and lung cancer. They covered a very wide range, from 1.2 to 36.0 for males, and from 0.2 (a negative association) to 5.3 in females. Professor Philip Burch, in 1983, commented as follows:

> "With ratios showing a range overall of more than two orders of magnitude it is not self-evident that any acceptable criterion of consistency has been satisfied".

(ii) There are considerable geographical and ethnic differences in lung cancer risk, regardless of smoking habits. Hinds et al (1984) found widely varying sizes of risk for the development of lung cancer associated with smoking in various ethnic groups in women in Hawaii. The authors concluded that factors other than smoking were important for the development of lung cancer in these groups of women.

(iii) Sex differences also exist in lung cancer risk that are independent of smoking habits: Burch (1978) discussed the fact that women smokers in many studies have been alleged to have consistently lower relative risk for lung cancer than men.

(iv) Many studies have suggested that the rate of lung cancer is rising in non-smokers against a background of decline, or no change, in lung cancer rates in smokers, and have suggested reasons why this might be so. For example, a number of papers are appearing in the scientific literature that suggest that the relative incidence of different types of lung cancer is changing. Squamous cell carcinoma, which is more common in smokers than non-smokers, has been declining in some countries relative to adenocarcinoma, which is more common in non-smokers. A number of authors have therefore suggested that, in countries where adenocarcinoma is increasing, non-smoker deaths from lung cancer and not smoker deaths are increasing. This is so in Japan (Hanai et al, 1987; Watanabe et al, 1987), China (Kung et al, 1984; Gao et al, 1987) and the USA (Gazdar et al, 1988; Anton-Culver et al, 1988; Reyes et al, 1987).

(v) Many factors other than smoking have been associated with lung cancer; these include radon, a radioactive gas that seeps out of granite rock and that has been found in high concentrations in houses and buildings built on this kind of rock. In 1986 the US Environmental Protection Agency reported that one in eight American homes harbour dangerous amounts of radon. Radon has been associated with lung cancer in a large number of studies (eg. Axelson, 1984; Archer, 1987).

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A number of studies have suggested that inhalation of diesel or petrol fumes are associated with lung cancer (eg. Blumer and Reich, 1980; Garshick et al, 1987; Gustafsson et al, 1986).

Lung cancer has been associated with a large number of occupations (see Blot, 1984; IARC, 1982). Sterling (1978) argues that many diseases associated with smoking may be of occupational origin and that smoking has been used to divert attention away from occupational and environmental hazards. Simonata et al (1988) note that in some populations, occupation can account for up to 40 percent of lung cancers.

Shy (1984) notes that epidemiological evidence suggests an association between air pollution and lung cancer. Johnston (1985) lists 99 chemicals for which recommended ambient air quality guidelines exist in the USA. A number of studies have identified particles in the lungs both of smokers and non-smokers, the source of which is assumed to be urban air. Churg and Wiggs (1987) found a wide variety of mineral particles in the lungs of urban, mobile, cigarette smokers and found that 80 percent of the particles from urban air have been suggested to be carcinogenic; for example, Sasaki et al (1987) reported that an organic extract of airborne particles was carcinogenic in mice. With reference to the home environment and indoor air quality, Leung (1977) suggested that the high incidence of lung cancer in women in Hong Kong is associated with use of the kerosene stove. Gao et al (1987) found that exposure to cooking oil vapours, particularly rape seed oil, similarly constituted a high risk factor for lung cancer in Chinese women.

A small amount of evidence exists to suggest that diet may be a factor in lung cancer. Wynder et al (1987) found that intake of calories from dietary fat was significantly associated with lung cancer mortality. Hinds et al (1983) found a dose-response relationship between dietary cholesterol and lung cancer in men.

Linn and Stein (1987) suggest that there are certain personality characteristics that can identify lung cancer patients. Interestingly, Mangan and Golding (1984) suggested that for mortality in general, amongst individuals leading stressful lives, smokers have lower mortality rates than non-smokers.

Tokuhata and Lilienfield (1963), Kramer et al (1987), Jones (1977) and Ooi et al (1981) suggest that lung cancer clusters in families, and that the clustering is not explained by familial tendencies to smoke.

(vi) A causal relationship between a factor (eg. smoking) and a disease (eg. lung cancer) should result in a sensible dose-response curve. Although many epidemiological studies have claimed such a relationship for smoking and lung cancer, Burch (1984) has discussed anomalies in the dose-response curve.

(vii) A number of papers, studying disease patterns over time and comparing them with cigarette consumption, have pointed out that the patterns of incidence of such disease from generation to generation does not always correlate strongly with patterns of smoking in these generations. Such studies have been carried out in the UK by Todd et al (1976), Belcher (1987), Osmond et al (1982, 1983) and Burch (1988), and by Levi et al (1987) in Switzerland. Unpublished work by Lee and his

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colleagues using a method called "cohort analysis", has investigated disease patterns and cigarette consumption in 14 different countries and in general failed to find correlations between disease and smoking incidence.

"the major cause of laryngeal cancer in men and women" (TSBR p8).

(I) Laryngeal cancer occurs much more frequently in alcoholics than non-alcoholics and therefore alcohol has been claimed also to be a primary risk factor for laryngeal cancer. Other risk factors include occupational exposures (asbestos, mustard gas, nickel, paint, welding, sulphuric acid, metal electroplating etc), vocal abuse, exposure to strong heat, working under poor ventilation, and chewing betel nuts (Wynder et al, 1956; Shettigara and Morgan, 1975; Manning et al, 1981; Pedersen, 1973; Olsen et al, 1984; Lynch et al, 1979; Tucker, 1935; Blumlein, 1957; Lin et al, 1979; Sarma, 1958).

(II) A number of studies have suggested anomalies in patterns of laryngeal cancer incidence compared to cigarette smoking rates. For example, de Stefani and Carzoglio (1985) indicated that laryngeal cancer in Uruguay is falling for younger generations against a pattern of increasing cigarette sales. Osmond et al (1983) found a wide variation in the incidence of laryngeal cancer in different generations that again is not correlated with cigarette consumption.

"a major cause of cancer of the oral cavity ..." (TSBR p8).

(I) Oral cancer is predominantly a disease of males, whereas smoking occurs in both sexes.

(II) Alcohol is significantly associated with oral cancer, as are occupational exposure to fumes and chemicals, dietary deficiencies (Mahbouhi and Sayed, 1982), poor dentition (Graham et al, 1977) and herpes simplex Type I virus (Decker and Goldstein, 1982).

(III) Wey et al (1987) found a high number of women non-users of tobacco and alcohol who had oral cancer, it was therefore assumed that other, as yet unidentified, factors must be at work.

"a major cause of esophageal (gullet) cancer" (TSBR p8).

(I) Oesophageal cancer is primarily a disease of males, whereas smoking occurs in both sexes.

(II) As with laryngeal cancer, alcohol has been claimed to be a significant risk factor for oesophageal cancer. Other risk factors include: diet, occupational exposure to metal dust, and tea drinking (Brown et al, 1988; Yu et al, 1988).

(III) Burch (1984) explored the basis for the association between cigarette smoking and oesophageal cancer. He reported that temporal trends in England and Wales from 1911 to 1980 showed that death rates from oesophageal cancer do not correlate positively with rates of cigarette smoking. Burch suggested that genetic predisposition may play a major role in oesophageal cancer.

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"a contributory factor for bladder cancer, pancreatic cancer, and cancer of the kidney" (TSBR p8).

Bladder and kidney cancer

(I) Although the US Surgeon General (1982) did not exclude the possibility of a causal role for smoking in cancers of the bladder and kidney, he did note that the association was not as strong as for other cancers claimed to be associated with smoking. The larger, prospective epidemiological studies have usually found relative risk ratios of around 2.0, which fall into the area of "low risk epidemiology", ie. the association is so small and epidemiological studies so imprecise that it is not possible to be sure, with a risk ratio of this small magnitude, that the risk is not explicable by confounding factors or poor methodology.

(II) For both bladder and kidney cancers in particular, occupation has also been claimed to constitute a risk (Brownson et al, 1988), as have artificial sweeteners (Miller, 1977). Hoar and Hoover (1985) found that truck drivers had a high rate of bladder cancer. Other suggested factors have been alcohol, tea, coffee, diet drugs, occupation and immune status (Kantor et al, 1988; Slattery et al, 1988; Najem et al, 1982).

Pancreatic cancer

(I) Dietary factors, chemical exposures and the presence of underlying diseases such as chronic pancreatis and diabetes mellitus have been strongly associated with pancreatic cancer (Morgan and Wormsley, 1977).

(II) Alcohol and coffee drinking are other major suggested risk factors (Williamson, 1988), which could also account for the low incidence rates of pancreatic cancer in groups such as Mormons and 7th Day Adventists who do not drink coffee or alcohol.

(III) The relative risk ratios in both prospective and retrospective epidemiological studies have averaged 1.5 - 2.0. This places them in the category of "low risk epidemiology", and it is therefore possible that such a result is due either to confounding factors or to poor methodology.

(IV) There is no known mechanism whereby cigarette smoking might influence the development of cancer of the pancreas. The British Medical Journal (1988) stated: "We know less about what causes it than we do about what causes most other common cancers".

"associated with cancer of the stomach" (TSBR p8).

Diet is believed to be the primary factor of significance in the aetiology of stomach cancer. Some industrial processes have also been associated with the disease, eg. aluminium production and working in the rubber industry (Tomatis, 1988).

"associated with cancer of the cervix" (TSBR p8).

(I) As pointed out by the US Surgeon General (1982), not all epidemiological studies have shown a positive association between

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smoking and cervical cancer. It is therefore by no means certain that smoking is a risk factor for cervical cancer.

(ii) Most studies that have found a small positive association between smoking and cervical cancer have explained it in terms of confounding factors. For example, cervical cancer is very strongly associated with sexual activity: women who have first sexual intercourse at an early age and who have a large number of sexual partners are claimed to be at a high risk of developing cervical cancer. This association has been explained by most experts to be a result of the fact that cervical cancer is believed to be caused by a virus (human papilloma virus).

Smoking has been noted by a number of scientists to be associated, in women, with high levels of sexual activity. It has therefore been suggested, in most studies in which an association has been observed between smoking and cervical cancer, that this is an artefact because of failure to standardise for sexual habits (La Vecchia et al, 1986; US Surgeon General, 1982).

2.3.2 *Trends in the estimated risks for those who smoke*

This data refers solely to the USA which may differ significantly from New Zealand in terms of climate, ethnic groups, demographic differences, etc (TSBR p8).

2.3.3 *Risks for women who smoke, compared with risks for male smokers*

All comments on previous sections, relating to problems in associating smoking with heart disease, stroke and lung cancer, apply equally well to women (TSBR p9).

In the UK, younger women are reported to be increasingly smoking. However, death statistics show that fewer younger women are dying of lung cancer than in previous generations, who smoked less (Royal College of Physicians, 1983).

2.3.4 *The personal risks of smoking: effects on life expectancy*

In adjacent sentences the Board concludes that "smokers who die from smoking die on average twenty-one years earlier than non-smokers" (TSBR p10) and then that "a male smoker in his thirties smoking two packs a day dies on average eight years sooner than a non-smoker" (TSBR p10). No attempt is made to explain why such widely varying estimates are used. St Leger (1989) claimed an average loss of life of 2.4 years. The figure is dependent upon the assumptions and mathematical technique employed. The fact is, as previously discussed, accurate statements on this subject cannot be made.

The statement that smokers die 21 years earlier than non-smokers refers to the 1989 Report of the US Surgeon General. In the Report, the figures referred to are from **unpublished** work by Warner estimating over the period 1964-1985 the amount of mortality claimed to be saved in the USA by decreases in smoking prevalence related to anti-smoking campaigns. These results are totally inapplicable to the statement appearing in the TSB Report.

2.3.5 *The risks to others from smoking*

(i) Although the Board has chosen to quote the US Surgeon General's view that cigarette smoking is a cause of disease in non-smokers, this view is not shared by numerous researchers around the world (TSBR p10). Many scientists have expressed doubt on the grounds of plausibility, deficiencies of the studies carried out, failure to control for confounding variables or to

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measure actual exposure levels, and the small size of the risk that is attributed.

(ii) The Board considers that smoking in pregnancy can result in severe problems. However, a number of studies have pointed out the difficulties of conducting competent studies on pregnancy outcome that allow assessment of the role of many different variables. However, where studies have carefully matched smokers and non-smokers for other lifestyle factors, they have generally failed to find an effect, eg. Alvar and Brooke (1977) showed no significant differences in five pregnancy outcome measurements. Boobis and Sullivan (1986) commented that several studies and much correspondence has built up a considerable body of evidence against a simple causal relationship between smoking and pregnancy outcome.

A number of medical authorities cite the result of randomised intervention trials during pregnancy, in which some women are advised to give up smoking and others are not. However, as noted by MacArthur et al (1987), it cannot be assumed that intervention results only in giving up smoking. Other behaviours may well change as a result of such intervention, eg. dietary behaviour.

Birth Weight

There are studies that cast doubt on the view that the claimed reduction in birth weight and magnitude of effect associated with tobacco smoking is a causal effect of smoking. Yerushalmy (1971) suggested that a number of other factors, eg. major lifestyle differences, such as contraceptive use and coffee and alcohol drinking, and socio-economic class, may be the underlying cause of low birth weight and that, since these factors are also associated with tobacco smoking, the claimed association between smoking and birth weight is an artefactual one.

Retarded mental and physical development

There has been considerable debate in the scientific literature on the significance of the data relating to child development and smoking in pregnancy. Boobis and Sullivan (1986) noted that the reported difference in height between children of mothers who do not smoke and those of mothers who do is on average 1cm; this is a tiny difference compared to the effects of other factors, eg. socio-economic class, and again, may be masking the effects of confounding variables.

A number of studies that have corrected for confounding factors have shown no significant differences in mental development between children of smokers and those of non-smokers (eg. Hardy and Mellitis, 1973; Callahan et al, 1982; Fogelman, 1980; Dunn et al, 1973, 1977). Boobis and Sullivan (1986) concluded as follows:

> "No consistent or clear effect on postnatal behavioural development has been established. However, it seems that other environmental factors predominate over the effects if any of smoking on this aspect of postnatal development."

Other effects

The US Surgeon General (1979) noted that there was inconsistency and controversy in the results of studies investigating the association between smoking and foetal and infant mortality; this is also true for studies of spontaneous abortion and complications of pregnancy and labour. As with the above effects, confounding factors and the difficulties of controlling for them remain a significant problem in the interpretation of these studies.

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3 *The human cost of cigarette smoking in New Zealand*

3.1 *Death and illness*

The TSB report (TSBR p12) frequently refers to "deaths due to smoking". Numbers quoted are in the vicinity of 4000, and are based on the paper by Gray et al, (1988). These numbers are in fact the numbers **attributable** to cigarette smoking: although the common language meaning of this word is "caused by", this is in fact a technical term, meaning "calculated by the process of applying estimated relative risks and estimated prevalences to population figures". It is important that such figures, when presented for public consumption, are not touted as having the dictionary meaning, but rather the more narrow and restrictive technical one. One aspect of attributable risk repeatedly ignored, or even hidden, by the authors of the TSB report is the fact that such estimates are constrained to be overestimates; another is that the attributable risk is still only a measure of association and not of causation.

The paper by Gray et al forms the basis of the Health Department publication "The Big Kill", wherein deaths attributed to smoking in all the Hospital Board areas are listed in detail. If in fact these estimates were reasonable, we would expect the estimates to correlate highly with the actual cancer deaths in each of these Hospital Board areas. These latter figures are available, from the National Health Statistics Centre (NHSC) publication "A Cancer Mortality Atlas of New Zealand" based on death certificate data. The correlation in fact turns out to be slightly negative, and very weak. This highlights the dangers of regarding estimates as legitimate observations.

3.2 *Smoking costs*

Detailed comments regarding the claimed "costs" to society from smoking are included from Sage Consultants (Appendix B, Section 3, p1). However, the general point can be made that the discussion is totally inadequate. It is simply not valid to add up costs of hospitalisation and medical care from so-called smoking-related diseases and unquestioningly assume that they are all associated with smoking. In any case they should be compared with costs incurred from diseases that are not associated with smoking. Everyone succumbs to a terminal illness or fatal accident, and unless there is evidence to show that non-smokers or ex-smokers die from causes that in themselves give rise to lower costs, then it could be argued that the costs should be no different. The argument that "tax is not new wealth, only a transfer payment from one section of society to another" is irrelevant and could be applied to any taxed product.

In order to reliably assess loss of life in relation to a specific factor, all other influences need to be excluded. In the real world, such an approach is not possible and assumptions have to be made from less than ideal data. Smokers and non-smokers are not randomly selected from a single population, and any increase in risk of death from a certain disease may be due to differences between smokers and non-smokers rather than to their smoking or not. Several studies (Seltzer, 1963, 1967; Heath, 1958; Lilienfield, 1959; Eysenck, 1959) have pointed out differences between smokers and nonsmokers in respect to socioeconomic status and genetic markers.

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4 *Cigarette smoking among young people, women and Maori*

For comments on this section, see report by Sage Consultants (Appendix B, Section 4, p1).

4.1 *Smoking among young people*

As usual, this section of the Report is full of unjustifiable assumptions, eg. that young people who are "daily smokers",

"... are probably addicted, and may well smoke for most of their adult lives" (TSBR p14).

This contrasts with evidence that is referred to on the following page that:

"... an increasing proportion of youth are quitting smoking before age 25, ..." (TSBR p15.

"By age 15, 33 percent of girls and 20 percent of boys were found to be daily smokers ... - 27 percent overall" (TSBR p14).

Dunedin children are far from representative of New Zealand school children as a whole. A "monthly" smoker is far from being a regular smoker.

The further assertion that the daily smokers "are probably addicted" (TSBR p14) is an abuse of the word **probably**.

"Census and survey data show that young people in New Zealand, that is, those aged 15 to 24, are now taking up regular smoking more than at any time since records began in 1976;" (TSBR p14-15).

The phrase "taking up regular smoking" is imprecise and lacking in definition. There are reasons to doubt the accuracy and comparability of the data:

- there are problems associated with obtaining accurate smoking rates from the New Zealand Census and particularly the errors inherent in the "last 24 hours" type of question.
- there is also the question of Census respondent accuracy when asked questions which many people may regard as irrelevant to the purpose of a Census.
- there is also the question of survey respondent accuracy when asked questions (possibly in the presence of parents), where the answers are associated with peer group pressures.

"Almost as quickly as smokers die or quit, their ranks are replaced by young smokers. The smoking population in New Zealand, therefore, is currently in a state of dynamic equilibrium ..." (TSBR p15).

This statement is not in accord with the downward fluctuations in the volume of tobacco consumption in New Zealand. It is also in contradiction to the New Zealand data on the percentage who smoke outlined in Table 7.5.1a (TSBR p68) and the tobacco consumption g/adult shown in Table 7.5.1c (TSBR p70).

4.2 *Smoking among New Zealand women*

The Report fails to note that, although smoking in New Zealand women has a prevalence comparable to, and in some age groups greater than, the prevalence for males, lung cancer rates are still very disparate. Our comments on the claimed

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associations between smoking and effects during pregnancy, cervical cancer, etc. can be found on pages 8-18 of this section."")

4.3 *Smoking among Maori*

The Report naively assumes that prevalence of lung cancer in Maori people is a function of their smoking habits alone. However, we have shown in previous comments on this section of the Report that lung cancer rates vary widely in ethnic groups whose rates of smoking are not very different. For example, Hinds (1984) who examined lung cancer rates in Chinese, Japanese and Hawaiian women living in Hawaii. Lung cancer rates varied widely, whereas smoking incidence did not.

Further, the two sections (4.2 and 4.3, TSBR p16-19) contain a series of allegations.

> "Associations of smoking with cervical cancer, miscarriage risks, cot deaths and post neonatal mortality may easily be artifacts of the association of smoking with a large number of lifestyle and child-care variables, largely associated with lower socioeconomic status and with youth. The usual criteria for supporting the proposal of cause are plausibility, consistency, specificity, temporality, strength, comparison with random variability and exclusion of confounding. Few if any of these criteria are satisfied in the case of the allegations in sections 4.2 and 4.3. Support is needed from international comparisons: Australia has experienced similar smoking history, economic influences and age structure, yet has a female lung cancer rate which is just over half that in New Zealand." (Appendix B, Sage, Section 4, p1).

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Appendix 1: Evidence that smoking causes disease

Many of the statements made in this section have been covered in previous comments on Part I of the TSB Report. However, there are some additional points that are relevant here.

Evidence that smoking causes fatal diseases

Persons affected

"Over 4000 deaths in New Zealand each year are estimated to be due to smoking-caused fatal diseases" (TSBR p119).

We have dealt with this fallacy in detail in previous sections.

Official support

"The eleven Royal Specialist Medical Colleges ..." (TSBR p119)

This hardly constitutes official support. It is an opinion that cannot be borne out by the evidence.

Evidence

Professor Beaglehole states that the statement that smoking is the cause of death for a large number of illnesses is not based on opinion and belief. However, he then goes on to say:

"It is now inconceivable that the associations demonstrated could be explained by genetic or psychosocial factors" (TSBR p119).

This statement is clearly based on opinion and belief. It may be inconceivable to Professor Beaglehole, but not to a number of scientists with international reputations working in these areas, and the Royal College of Physicians in the UK (1983). For example:

(i) Professor P R J Burch (1978) put forward a constitutional hypothesis to account for the association between smoking and lung cancer:

> "Adopting that viewpoint, genetic factors that predispose to neoplasia associate positively with those that predispose to smoking".

(ii) A number of investigations have shown that lung cancer frequently runs in families, regardless of the smoking habits of the individual member of the family (eg. Kramer et al, 1987; Tokuhata and Lilienfield, 1963). This has been interpreted as an inherited genetic factor.

(iii) Many clinical studies have indicated significant genetic differences between patients with diseases such as lung cancer and those without such diseases. For example, Ayesh et al, (1984) noted that individuals differ in their capacity to metabolise procarcinogens into active carcinogens. Poor metabolisers do so ineffectively, and have a lower risk of lung cancer than extensive metabolisers, who therefore have a high risk of lung cancer. This particular genetic predisposition to develop lung cancer is well established and is independent of exposure to other factors, but for example, can interact with occupational exposure.

Professor Beaglehole notes information provided by the Tobacco Institute of New Zealand that indicates that the average age of death for smoking-associated diseases is greater than the average for all causes. However, he claims that:

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"All it indicates is that the risk of dying from a smoking-caused disease increases markedly with increasing age, that is, with increasing duration of smoking" (TSBR p119).

This comment is irrelevant, incomprehensible, and does not follow at all from the Sage Consultants' calculations.

"Studies on millions of smokers and non-smokers show, in many different populations, that tobacco smokers have much higher death rates compared to non-smokers in the same population" (TSBR p119).

This statement is illogical. Smokers have indeed been claimed to have higher death rates than non-smokers **from certain diseases**, but since all individuals eventually die, they can hardly be said to have higher death rates overall.

"The increased risk for smokers versus non-smokers is true for both men and women, for different countries, different races, climates and occupation" (TSBR p119).

This is rather simplistic. Risk ratios for males and females differ considerably in size, which does not reflect differences in smoking habits.

Hinds et al (1984) found widely varying relative risks for lung cancer associated with smoking in various ethnic groups of women in Hawaii. It is well-known that death rates for the so-called smoking-associated diseases in different countries vary widely. The comparative incidence of these diseases for a range of countries does not correlate with the comparative incidence of smoking.

"The effect is dose-related. The greater the number of cigarettes smoked, the greater the risk. For those who stop smoking the risk reverts, after about 15 years, to that of a non-smoker" (TSBR p119).

Again, there is a simplistic acceptance of a clear dose-response relationship. A number of anomalies in the dose-response data have been discussed by Burch (1984). For example, he noted that data for the British doctors' study (Doll and Peto, 1976) fitted a quadratic relationship, whereas the Japanese males' study fitted a sub-linear relationship. Lee (1979) concluded that, in the British doctors' study,

> "... the benefits of giving up smoking may not be so great as has commonly been assumed".

In fact he counselled that:

> "Those considering bringing pressure to bear on society to reduce smoking should keep in mind that, for some smokers at least, giving up smoking may have adverse consequences ... the benefits to be gained may well be fewer than many sources would have us believe".

"Pipe and cigar smokers have a small definite increased overall mortality risk compared to non-smokers. Again, this is dose-related" (TSBR p119).

To give just one example, the British doctors' study (Doll and Peto, 1976) found no significant increase in mortality for pipe and cigar smokers.

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Evidence that smoking causes lung cancer

Persons directly affected

"Smoking causes nearly 1,000 premature deaths due to lung cancer per year in New Zealand" (TSBR p120).

As previously discussed in this submission it is not valid to enumerate deaths claimed to be caused by smoking or by any other risk factor.

Official support

"Cigarette smoking is the main cause of lung cancer in both men and women" (TSBR p120).

We have argued elsewhere in this document that this is a matter of opinion and cannot be scientifically substantiated.

"Cigarette, cigar and pipe smoke tars are carcinogenic to mice skin" (TSBR p120).

Mouse skin carcinogenesis is a very poor model for human cancers, and is recognised as such by toxicologists. It certainly bears no relevance to the inhalation route, which would be the most appropriate route for testing cigarette smoke. The Board selectively omit to note that, in tests using the more appropriate route of animal inhalation, there has been little success in inducing lung tumours by exposing animals to cigarette smoke.

"One of the most powerful chemicals in tobacco smoke, the nitrosamine NNK, selectively causes lung cancer in rats, mice and guinea pigs. One milligram of NNK injected once is sufficient for this" (TSBR p120).

Injection into animals of a substance that is usually inhaled by humans is not a valid comparison. In the study referred to, it is noted that "smoke inhalation did not result in an increase in respiratory tract tumour incidence in most of the NNK treated groups". Even given the differences in route of administration, one milligram of NNK is a dose far above that which would be delivered in cigarette smoke.

The fact that animal inhalation studies with whole cigarette smoke have not been successful in demonstrating lung tumours would argue against the suggestion that NNK is an effective animal carcinogen by that route of administration and in those doses.

"Cigarette smoking has been followed by increased lung cancer death rates in men and women, in different races, age groups, occupations and countries. In New Zealand, 94 percent of registered lung cancer patients are or have been smokers" (TSBR p120).

It has been noted earlier in this submission that (a) in most countries studied cigarette smoking has not been followed by increased lung cancer but in fact lung cancer deaths have peaked and then begun to decline at times that are not consistent with patterns of smoking; (b) death rates in men and women for lung cancer vary enormously; (c) ethnic and geographical differences in susceptibility to lung cancer are extremely significant; (d) a number of eminent scientists (eg. Sir Ronald Fisher, Professor Philip Burch) believed that those with an inclination to smoke tobacco were also susceptible to lung cancer.

"The risk is increased for those who smoke more cigarettes per day, inhale more deeply, smoke from a younger age, smoke for more years, smoke higher tar cigarettes. Heavier smokers incur much greater risks. Twenty-five

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cigarettes a day increases the risk - about twenty-five times over that of a non-smoker" (TSBR p120).

There is controversy about these statements. For example, the British doctors' study (Doll and Peto, 1976) found a **reduced** risk in inhalers, and there are other studies finding a negative relationship. The statement that 25 cigarettes a day increases the risk 25 times over that of a non-smoker comes from Doll and Peto and was based on only seven deaths among non-smokers.

"Stopping avoids about 80 percent of the excess risk that would have occurred with continued smoking" (TSBR p121).

The basis of this statement is unclear and must in any case be a massive over-generalisation.

"Pipe and cigar smokers: Lung cancer death risks are greater than for non-smokers. The effect is dose-related" (TSBR p121).

Results from the four major prospective studies are varied, ranging from non effect for cigars (Hammond and Horn, USA, 1958) to a maximum risk ratio of 5.80 (British doctors' Study, Doll and Peto, 1976) for cigar and pipe smoking. Most results fall into the category of low risk epidemiology and thus are subject to confounding by other factors.

Comment

"Dr Sharon Boyse... implicated a wide range of factors as causing lung cancer, but did not include tobacco or cigarettes in her long list" (TSBR p121).

Dr Boyse's slide on factors associated with lung cancer, which was subsequently made available to the Board, had smoking on the top of the list. This statement is therefore untrue. It should be noted that this was a list of factors that have been **associated with** lung cancer, not a list of factors that **cause** it. Causality has not been established for any of these. The Board choose to stress this point whilst ignoring other substantial points that were made during this presentation, such as declining lung cancer rates in many countries, unrelated to smoking habits.

"The other postulated causes pale into insignificance in comparison with smoking"(TSBR p121).

This is clearly a matter of opinion, and not one that was held by the US Environmental Protection Agency when they attributed 30 percent of lung cancer deaths to radon, or by Simonata et al (1988) when they attributed 40% of lung cancer deaths in some populations to occupational exposure.

Evidence that smoking causes heart disease

Persons directly affected

"Smoking causes over 1,000 premature coronary deaths yearly in New Zealand" (TSBR p121).

Again, it is not valid to enumerate deaths claimed to be caused by smoking or by any other risk factor.

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Official support

"Smoking is causally related to coronary heart disease in the common sense of that idea and for the purposes of preventive medicine" (TSBR p121).

Whether or not smoking is causally related to coronary heart disease should surely be a question for science rather than for convenience or "for the purposes of preventive medicine". In fact, there is no evidence that, for the purposes of preventive medicine, a reduction in claimed risk factors such as smoking has a beneficial effect on mortality rates from coronary heart disease (eg. MRFIT, 1982).

Evidence

"Dr Boyse ... stated that there is no known biological mechanisms to explain how cigarette smoking might cause heart disease. Professor Beaglehole disagreed ... (1) smokers have increased atheroma (diseased artery linings)" (TSBR p121).

Many other scientists have agreed that the mechanism by which smoking is presumed to affect heart disease is not known. This was admitted by the UK Royal College of Physicians in their 1983 report. The relationship between atheroma and coronary heart disease is poorly understood and therefore can hardly be said to provide a "known biological mechanism".

"Smoke contains nicotine and carbon monoxide, both with known effects on the heart and circulation" (TSBR p121).

Whatever effects nicotine may have on the cardiovascular system they are acute and not prolonged effects, and are not significantly different from the effects of mild exercise (Bassenge, 1988; Becker and Gerlach, 1988). It has never been scientifically established that carbon monoxide has any effect on heart disease. Smokers as well as non-smokers are in any case exposed to large amounts of carbon monoxide daily from vehicle fumes.

"Cigarette smoking also raises blood lipid levels and affects clotting (and hence can induce sudden coronary thrombosis...)" (TSBR p121).

The effects of cigarette smoking on critical factors such as platelet aggregation are conflicting; this is therefore an overstatement. Many studies have found no effect at all (eg. Taylor et al, 1987).

"Cigarette smoking has been followed by increased coronary artery disease death rates in men and women, in different races, countries, age groups and occupations ... Dr Boyse stated that the decline in coronary disease bears no relationship to the decline in cigarette smoking" (TSBR p121).

Since around 250 factors have been identified that have been claimed to be associated with coronary heart disease, and since there is such a small association between smoking and heart disease, it is extremely unlikely that smoking could induce any significant change in heart disease rates. In many countries (as previously mentioned) heart disease began to decline well before smoking began to decline. In Japan, which has one of the highest percentage of smokers for the male population of anywhere in the world (around 80 percent) heart disease has always been a relatively rare disease. Marmot et al (1981) noted that, in a number of different countries, "trends in heart disease mortality in men showed no correlation with trends in cigarette consumption".

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Professor Beaglehole's statement that:

"the decline in per capita consumption of tobacco predated the onset of the decline coronary heart disease mortality (Figure A1)" (TSBR p121).

is unconvincing to say the least. Firstly, while the coronary data show a rise until about 1968, and then a fall from about 1974 in a fairly well defined manner, the tobacco data show no real evidence of a peak at all. Secondly, it should be pointed out that the tobacco data are **per adult for all ages**, whereas the coronary data are for **45-64 year old men**. The whole statement is therefore invalid and misleading.

"Dr Boyse noted ... For smokers, however, the risk of premature death by heart attack is at least double the risk for non-smokers. There is thus a clear dose-response relationship" (TSBR p122).

The statement that "for smokers the risk of premature death by heart attack is at least double the risk for non-smokers" has absolutely no bearing on the question of dose-response, which would require evidence that heavy smokers are more at risk than light smokers. We repeat our earlier reference to a statement by Sir Richard Doll and Richard Peto, whose viewpoint has been accepted by many eminent epidemiologists: they stated that when rates

> "among exposed people are only a moderate multiple of those among the unexposed (eg. when the relative risk lies between 1 and 2) ... problems of interpretation become acute, and it may be extremely difficult to disentangle the various contributions of biased information, confounding of two or more factors and cause and effect".

Under these circumstances any relationship is difficult to establish, let alone a dose-response relationship.

"Professor Beaglehole, however, pointed out: the Surgeon General's criteria for causality do not have to be met in every case. It is the overwhelming weight of the evidence when viewed in total that indicates the causality of the relationship between cigarette smoking and coronary heart disease and lung cancer" (TSBR p123).

This statement is a poor reflection of epidemiology as a science. **Apparently Professor Beaglehole finds no difficulty in simply rejecting evidence that does not fit into his theory by saying that criteria for causality do not have to be met in every case.** The eminent philosopher of science Sir Karl Popper, noted that it is always possible to evade evidence that would otherwise falsify a theory. If certain evidence is in inconsistent with the consequences of the theory, he said, then a number of strategies are often pursued to "save" it. The conflicting evidence may, for example, be rejected outright. According to Popper, proper scientific method is continually to expose a theory to the possibility of being falsified. The rules of empirical method "must be designed in such a way that they do not protect any statement in science against falsification" (Popper, 1974). Professor Beaglehole's statement that it is the "overwhelming weight of the evidence that must be considered, regardless of the inconsistencies in that evidence", **reduces what should be a scientific process to the realms of opinion and belief, one accusation that he was keen to reject** (TSBR p 119).

"Cigarette smoking is a major cause of coronary heart disease, causing 30 percent of all coronary heart disease in the United States and is responsible for at least 25 percent of all deaths from heart disease" (TSBR p123).

We have argued elsewhere in this submission that such attributions are meaningless. This is particularly so for heart disease, with 250 potential risk factors.

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"Risk increases with the number of cigarettes smoked, degree of inhalation and years smoked. Heavy smokers have two to three times greater risk of death than non-smokers and have four times the coronary disease rate of non-smokers" (TSBR p123).

Given that the risk ratio in studies that have claimed a positive association is very low, it is difficult to see how it would be possible to distinguish a significant effect of dose or inhalation.

"On cessation of smoking, the coronary death risk for these ex-smokers declines" (TSBR p123).

The evidence for this statement is unconvincing. A number of multinational intervention trials have been carried out recently in which large numbers of people were encouraged to reduce or stop smoking, and were compared to individuals who did not change their behaviour. Four such trials were in Oslo (Hjermann et al, 1981), USA (MRFIT, 1982), UK (Rose et al, 1983) and Belgium (Kornitzer et al, 1983). Reduction of cigarette smoking was achieved in all studies but no reduction in cardiovascular mortality was achieved.

"Filters and low tar cigarettes: on present evidence, these do not clearly cause less heart damage than plain or high tar cigarettes" (TSBR p123)

Surely this is evidence against Professor Beaglehole's theory and would argue against a dose-response relationship?

Evidence that smoking damages lungs

Persons directly affected

"Over 800 deaths per year in New Zealand are attributable to bronchitis and emphysema"(TSBR p123).

This does not mean that smoking is implicated in those 800 deaths. In addition, people rarely die of bronchitis: it is a chronic disease that does not usually, of itself, cause death.

Official support

"Cigarette smoking is a major cause of chronic obstructive lung disease in the U.S. for both men and women. The contribution of cigarette smoking to chronic obstructive lung disease outweighs all other factors" (TSBR p123).

Again, the latter statement is speculation and cannot be borne out by facts. There are a number of important risk factors for chronic obstructive lung disease, and particularly occupational exposure and air pollution. Chronic obstructive lung disease had been a major health problem in all industrialised countries long before cigarette smoking in these countries became common (Fletcher et al, 1976).

Evidence

"Tobacco smoke .... Lung function and structure are repeatedly damaged" (TSBR p123).

The US Surgeon General in 1984 remarked that on tests of lung function (eg. FEV1) "smokers are not sharply separated from non-smokers". It is also noted that, with ageing, measures of function begin to deteriorate after age 25-30, whether a person is a smoker or not.

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"Cigarette smoking has been followed by increased chronic obstructive lung disease death rates in people of different sex, race, country, age group and occupation" (TSBR p123).

This is an overstatement. For example, the UK Royal College of Physicians (1983) noted that "women are to some extent protected from ... obstructive lung disease". The same report noted that "there was no dramatic rise in death rates from chronic obstructive lung disease that parallelled the rise in tobacco consumption". It also noted that "there are striking differences between social classes 1 and 5 in chronic obstructive lung disease death certification that cannot be explained in terms of differences in smoking habits".

"Postmortem studies show mild to moderate emphysema in most smokers, but rarely in non-smokers" (TSBR p123).

This statement does not accord with scientific findings. The UK Royal College of Physicians in 1983 noted that "airflow obstruction appears to affect only a minority of smokers, who may therefore be unduly susceptible in some way". This was also noted by the US Surgeon General in 1984, who also stated "Many smokers with small airways dysfunction may never progress to significant airflow obstruction".

Summary

Members of the Board accept, uncritically and at total face value, any scientific study that can be used to imply that smoking is undesirable. They display a most **unscientific** selectivity in their use of scientific evidence, totally ignoring any evidence that does not fit comfortably with their hypothesis. Evidence of the particularly unscientific approach of the Board can be seen from sentences such as:

"The Surgeon General's criteria for causality do not have to be met in every case" (emphasis added), (TSBR p123).

And:

"Smoking is causally related to coronary heart disease in the common sense of that idea and for the purposes of preventive medicine" (emphasis added), TSBR p121).

The Board agreed to hear presentations by experts in some of the areas covered by the Report, and then dismissed the views of these experts out of hand. Professor Warburton, an internationally reputed scientist in the area of addiction, was summarily dismissed in one sentence. The account of Dr Boyse's presentation and its implied rebuttal by Professor Beaglehole was, as can be seen from our comments, one-sided, inaccurate and petty.

Throughout the Report, the Board naively assume that it is possible to identify a specific number of deaths that (they claim) are caused by cigarette smoking. It is certainly possible to estimate the annual numbers of deaths from the so-called smoking-associated diseases. However, it is not possible to determine whether any of these deaths could be stated to be caused by tobacco smoking and, if so, how many. In addition, death certificates do not record whether or not an individual was a smoker. Such an approach totally ignores the many additional factors associated with lung cancer, eg. occupation, air pollution, etc.

When discussing the claimed associations between smoking and certain diseases, the Board totally ignores the critical distinction between association and causality. It cannot be proven by epidemiological studies that smoking is a cause of disease. The Board also totally ignored evidence showing that animals exposed to cigarette smoke do not develop more lung tumours than unexposed animals. Similarly, the Board ignore a number of interesting anomalies in the epidemiological data, eg. trends in disease usually do not match trends in cigarette consumption; there are

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many factors other than smoking that are associated with so-called smoking-associated diseases.

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